as large as their probable errors, all but one are positive. The average value of the 15 coefficients (regarding signs) is +0.1212. Furthermore, two of the negative coefficients (IV and XI) are based on measurements from the same general region and are deduced from data emphasized as far from satisfactory by Douglass himself. The third series which indicates a slightly negative relationship (XIII) is noted by Douglass as having apparently been subject to a profound change in environmental conditions during the course of development.

On the other hand it is interesting to note that the four longer series (I, XIII, XIV, XVI) which cover the entire period for which sun-spot numbers are available, and which in consequence should be expected to show the highest correlations, actually show some of the lowest coefficients available. These have been subdivided into two periods, with a view to determining whether the inferior accuracy of the sun-spot numbers in the earlier years might be the source of the lower correlations for the longer periods of time.

Since a number of the other series cover the period 1820–1830 to 1910–1920, these four series have been broken at the year 1830. The results appear in the lower portion of the table. Series VIII and XIV show at least an apparent strengthening of the correlation due to the division of the materials. Improvement is not evident in Series XIII and XVI.

In stressing the smallness of these (generally positive) values, it is proper to emphasize two points:

(a) The correlations are between the sun-spot numbers and the growth increments of the same year. It is conceivable that there may be an anticipation or a lag in the biological consequences if solar activity as expressed in sun-spot number can be regarded as a real cause.

(b) The coefficients are the raw values, uncorrected for the influence of secular change in growth rate. Correction has not been attempted because of the excessive labor of calculation when grouping of the data can not safely be attempted. Let t = time, s = sun-spot number, r = width of growth rings. The corrected value should be given by the partial correlation coefficient between sun-spot numbers and tree ring dimensions for constant time, i. e.,

$$ {}_t r_{sr} = \frac{r_{sr} - r_{st} r_{rt}}{\sqrt{1-r_{st}^2}\sqrt{1-r_{rt}^2}} $$

Now for data extending over a reasonably long period of time r_{st} should approach 0. General botanical experience would lead us to expect that r_{rt} will be negative in sign. Inspection of the formula will, therefore, suggest that the usual effect of correction will be to raise the values of the coefficients as given here.

Taken as a whole these coefficients indicate a low positive correlation between sun-spot number and tree growth. The relationship is by no means so intimate as many writers imply.

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NOTES, ABSTRACTS, AND REVIEWS

TABLES FOR COMPUTING HARMONIC ANALYSIS

For students in meteorology, physics, engineering, economics, and other branches of science who find it necessary to compute periodograms, Fourier series, or harmonic analyses in other forms, there are now available Dr. Leo W. Pollak's *Rechentafeln zur Harmonischen Analyze* (published by Johann A. Barth, Leipzig). These tables will doubtless facilitate harmonic analysis fully as much as do the well-known Crelle Rechentafeln for multiplication and division.

The harmonic tables are in quarto form of about the same size and general external appearance as the Crelle tables.

Twelve pages of printed German text mention the purposes and advantages of tables for harmonic calculations, citing other publications and discussing the arrangement of the tables in two parts, I and II, with comments on the accuracy and verification of all computations.

Six additional pages, also in German, give general and detailed explanation of the use of the tables, with citations to the literature, concluding with the detailed computation of five examples of single wave forms by mental arithmetic as well as with the aid of computing machines. One example explains how a single higher harmonic (fifth) may be found.

Two of the examples show abridgments of the computations: First, when the considerable number of phase values (35) is odd, and, second, when the relatively large number (32) is divisible by four.

The reviewer can only remark that for a great number of possible users the value of the table would be much enhanced if the text accompanying them were printed in full in the English as well as the German language.

The tables are unique in a typographic sense, because printed from phototyped plates of hand-written original copies.

In problems of the harmonic analysis we must evaluate the amplitude of sine and cosine functions for elemental wave forms having observed or assigned values of the function at widely varying numbers of equidistant phase intervals.

Table 1 provides for every integral number of equidistant intervals from 3 to 40, inclusive, for each of which are tabulated the values of

$$ iz = \frac{360°}{n} z \Big]_{z=0}^{z=(n-1)} $$

The natural and the logarithmic sine and cosine of iz are also given and where required a reference to the page in Table 2 where products are to be found.

Table 2 comprises 120 pairs (pages). Pair 6, for example, is headed,

$$ \text{Sin } 38° \ 34' \ 17.''14 \ \cos \ 51° \ 25' \ 42.''86 = 0.6234898 $$

The table gives, to six significant figures, the products of the above number by all numbers from 1 to 1000, tabulated in all respects similar to the well-known Crelle tables. Two pages are obviously required.

A computer must of course become familiar with the requirements of the Fourier analyses and attain some proficiency in the use of these tables before their full value is realized.—*C. F. Marvin.*